

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

*In re* Application of:  
Smith et al.

Confirmation No.: 7897

Serial No.: 10/656,574

Filed: 5 September 2003

Group Art Unit: 1733

Examiner: Aftergut, Jeff H

For: CONDUIT AND METHOD OF  
FORMING

Attorney Docket No.:  
1171/41365/Case 135

STATUTORY DECLARATION OF PETER N PLIMMER  
UNDER 37 C. F. R. § 1.132

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

I, PETER NEVILLE PLIMMER, of Auckland, New Zealand, do solemnly and sincerely hereby  
declare as follows:

1. I am a Dr (Ph.D.) of organic chemistry and currently a part time lecturer at The University of Auckland, teaching several courses on polymer technology.
2. Prior to retiring to New Zealand, I had a 30 year career with the DuPont Company in the United States. At retirement I held the position of Manager of Technology Development.
3. I am a resident of 493 East Coast Road, Browns Bay, North Shore City, New Zealand. A copy of my *Curriculum Vitae* is attached as **Exhibit PNP1**.

4. I have read US 2,748,830 - Method and apparatus for making spiral wound synthetic piping and tubing (Nash), and US 2,250,430 - Process and apparatus for forming tubing (Wade).

5. **Processing Modified Cellulose-Based Polymers**

Looking at US Patent 2,250,430 (Wade), it would appear that they seem to recognize that a cellulose-based polymer cannot be heat welded or fused to itself, because:

- (a) They prefer the use of “*pretreated* tube-forming material which makes it more plastic” (page 1, column 1, lines 35-40) and,
- (b) In the section p.2, column 2, line 65 to p.3 column 1, line 7; is the statement:  
“...to material which is inherently heat-fusible, i.e. a material such as cellulose acetate, as well as material *rendered heat sealable by reason of being treated with an adhesive solvent and/or softening agent or which has been coated with a heat-fusible composition*”.

6. There is a major error in (b) above. Cellulose acetate is *not* an inherently heat-fusible material, since it decomposes before it actually melts.

7. However, a heat-fusible version was available commercially (Tennessee Eastman used to offer a Tenite<sup>R</sup> product line) as cellulose acetate *modified by the addition of considerable level of a material called a ‘plasticizer’* (up to 25% by weight, Principles of High Polymer Theory and Practice, Schmidt and Marlies p. 311 & p. 653 attached as **Exhibit PNP2 and PNP3**).

8. **Solvent Welding**

Plasticizers present in a product such as Tenite<sup>R</sup> act like ‘internal lubricants’, allowing the cellulose acetate polymer chains to slide over themselves when exposed to heat and pressure. Thus a *plasticized cellulose acetate* will appear to ‘melt’ and ‘flow’ when processed by conventional thermoplastic moulding techniques.

9. So, if a plasticizer is present in a material such as cellulose acetate film, it will inevitably be located at the interface between two overlapping plasticized cellulose acetate *films*, and will act as a ‘softening agent’. This will provide a site for adhesion (fusing) since the cellulose acetate polymer chains will ‘migrate’ from one film layer to the other, through the plasticizer, to form a continuous (adhesive) linkage between the overlapping layers.

This technique is called “solvent welding” and is commonly used in the plastics industry (Schmidt and Marlies p. 653 attached as **Exhibit PNP3**). The heat and pressure manufacturing

conditions described in Wade would encourage 'solvent welding' of a *modified* cellulose acetate to occur.

10. However, US 2,748,830 (Nash) at Column 2, line 23 refers to "plain or unlacquered cellophane" and does not suggest a modified cellulose acetate material. Cellulose acetate is not the same material as regenerated cellulose (cellophane).

12. **Heat Welding of Cellulose-Based Polymers**

The answer to the question regarding whether or not "plain or unlacquered cellulose" (as disclosed in Nash) is a heat-weldable material, is an emphatic 'no'. Regenerated Cellulose (cellophane) *does not* melt as it *decomposes* before reaching a temperature at which it's molecular chains become "mobile" enough undergo melt fusion (welding).

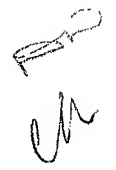
13. **Processing of Cellulose-Based Polymers**

Cellulose, or more specifically regenerated cellulose, is commonly called *viscose rayon* when formed into fibre, and *cellophane* when formed into film. The term 'formed' is used because the process used to make this fibre or film shape does not involve melting the cellulose - these shapes are the result of a spinning or casting process where the starting material is dissolved in a solvent (Fred Billmeyer, Textbook of Polymer Science, pp. 445 to 447 attached as **Exhibit PNP4**).

14. This method of processing is employed because the melting point of cellulose is far above the temperature at which it decomposes. Only a few cellulose derived materials actually melt E.g. Ethyl cellulose, which has a melt point of 240-255°C. There are no values for melting point for other cellulose-based polymers recorded in the Handbook of Chemistry and Physics, 44<sup>th</sup> Edition, pp 916-919 (attached as **Exhibit PNP5**). There are only a few values for melting point for other cellulose-based polymers recorded in Schmidt and Marlies p. 182 (attached as **Exhibit PNP6**).

15. Since cellophane does not melt, it is impossible for "plain or unlacquered" cellulose film (cellophane) to weld (fuse) to itself.

16. The answer to the question "does the process described in US 2,748,830 (Nash) result in the cellophane layer fusing to itself?" is again 'no'.



17. The process described in 2,748,830 (Nash) would *not* create a permanent weld between overlapping layers of "plain or unlaquered" cellulose (cellophane) film. The temperatures used in the Nash process to 'cure' the polyester resin/fiberglass composite pipe structure would, indeed, cause the cellophane film to shrink, but would have no effect on its ability to bond with itself.
18. Finally, I hereby declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the *United States Code* and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

DECLARED at )  
Auckland, New Zealand )  
this 23 day of MAR 2007 )

  
PETER N PLIMMER, Ph.D.

BEFORE ME:

  
A Solicitor of the High Court of New Zealand/Justice of the Peace

CHARMIAN S.M. OH  
SOLICITOR  
AUCKLAND

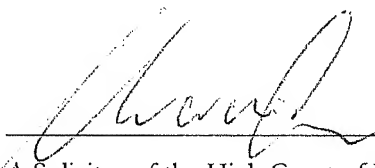


**Exhibit PNP1**

This is the exhibit marked "PNP1" referred to in the annexed Statutory Declaration of  
PETER N PLIMMER Ph.D.

Declared at Auckland this 23<sup>rd</sup> day of March 2007

BEFORE ME:

  
A Solicitor of the High Court of New Zealand

CHARMIAN S.M. OH  
SOLICITOR  
AUCKLAND



**PETER N. PLIMMER Ph.D.**

**493 East Coast Road, Browns Bay, North Shore City**

**pplimmer@xtra.co.nz**

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**SUMMARY**

Retired after a thirty-year career with the DuPont Company in the United States. This incorporated a broad spectrum of experience involving Research, Market Development, and Manufacturing of high polymers. Held the position of Manager Technology Development at retirement.

**RELEVANT EXPERIENCE 1962 - 2005**

**Independent Consultant, 1992 - present**

**International**

- ✦ Developed a novel, oil-resistant thermoplastic elastomer which is currently undergoing market introduction in Europe.
- ✦ Developed soft alloys and blends - specifically for use in foamed footwear, wire insulation, and closures.
- ✦ Solved critical quality problems in the manufacture of fluoroelastomer seals, and in oil-resistant insulation used in submersible pumps connectors.

**Domestic**

Part time lecturer at Auckland University, teaching several courses on polymer technology:

- ✦ Chemistry 750 (Novel Polymers), at graduate level.
- ✦ PAMPITO Levels 4 and 5 - 'Polymer Technology' courses.



- Stages 2 and 3 of the PNZ/Auckland University-promoted 'Diploma in Design and Specification of Plastics' course.

#### **Manager Technology Development, DuPont, 1990 - 1992**

- Accelerated the development, aimed at faster penetration of technology into the marketplace, of new "barrier" technology - a recyclable, Freon-resistant, flexible polyamide- replacing non-recyclable thermoset automotive air conditioning hose. Reduced development time and cost by 30%, resulting in \$1 million savings.

#### **Senior Research Supervisor, DuPont, 1971 - 1990**

Ethylene Copolymers: Worldwide responsibility for both process and product research for polymers designed for packaging, adhesives, sporting goods and industrial end uses. Specific technologies - thermoplastic elastomers, ionomers, chemically functional polymers and reactive compounding.

New Business development: Managed this arm of the Polymers Research and Development Division, test marketing significant new product technology in order to confirm its value-in-use. This included an all-plastic, low attenuation fiber optic cable, corrosion-resistant fluoropolymer/carbon fibre composites for metal replacement, and hydrocarbon-resistant blow moulded HDPE automotive petrol tank.

Fluoropolymers: Directed the process and product research for thermoplastic and thermoset fluoropolymers. This included the development of perfluorovinyl ether monomers as well as fluorinated cure site monomers.

#### **Market Development Representative, DuPont, 1965 - 1971**

Fluoropolymers: Part of a 'technical task force' charged with the responsibility of developing new, non-military markets for fluoropolymers (Teflon<sup>®</sup>).

- ✦ Worked closely with architectural and engineering design houses in New York City.  
Developed low friction, load-bearing, sliding ('bearing') pads used in curtain walls, bridges and tunnels.
- ✦ Introduced non-burning insulation for signal and power cable for the NYC Transit system.

### Research Chemist, DuPont, 1961 - 1965

#### Fluoropolymers:

- ✦ Corrected a 20-year old colour (end group stability) problem peculiar to Teflon<sup>R</sup> TFE.
- ✦ Developed the aqueous polymerization process for Teflon<sup>R</sup> PFA.

### EDUCATION

Ph.D Organic Chemistry, 1962, "Telomerization and Polymerization of Fluorinated Olefins",  
University of Durham (England)

B.Sc. (Honours) Chemistry, 1959, University of Durham (England)

### PATENTS

US Patent 3,419,512 (1966) 'Non-graying, non-yellowing polytetrafluoroethylene moulding powder'

US Patent 4,503,192 (1985) "Cured elastomers with improved high temperature tear strength"

Pending European patents (1995): 'Compositions of elastomers dispersed in thermoplastic matrices', and 'Process for increasing the crosslinking density of TPE's made by solid state grafting of thermoplastics'

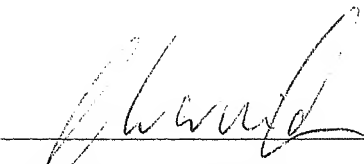


**Exhibit PNP2**

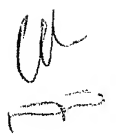
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high-polymer industry. Appropriate references will be found in Appendix A and at the ends of chapters of this text.

**801. Binders.** The binder, or binding polymer, is the material that acts as the matrix which ultimately cements the ingredients of the mix

TABLE 8-1. EXAMPLES OF HIGH-POLYMER MIXES  
Automobile Tire-tread Mix (Ready for Vulcanization)

Ingredient	Type	Parts by wt
Rubber .....	Binder	100
Carbon black .....	Reinforcing filler	50
Sulfur .....	Vulcanizing agent	0.5-3.5
Accelerator .....	Catalyst	0.5-1.5
Zinc oxide .....	Activator	1-10
Stearic acid .....	Activator	0.5-2.0
Pine tar .....	External plasticizer	3
Antioxidant .....	Aging inhibitor	0.25-1.5

Thermosetting Molding Compound (Ready for Compression Molding)

Ingredient	Type	Wt %
Phenol-aldehyde resin .....	Binder	43.0
Wood flour .....	Filler	51.0
Hexamethylenetetramine .....	Catalyst; hardener	3.7
Black dyes and pigments .....	Coloring materials	1.5
Metallic soap .....	Lubricant	0.8

Thermoplastic Molding Compound (Ready for Injection Molding)

Ingredient	Type	Wt %
Cellulose acetate .....	Binder	74.6
Diethyl phthalate .....	External plasticizer	24.8
Carmin red .....	Coloring material	0.4
Montan wax .....	Lubricant	0.2

Dope for Making Transparent Film (Ready for Casting)

Ingredient	Type	Wt %
Cellulose acetate, medium viscosity .....	Binder	15
Triphenyl phosphate } .....	Permanent external plasticizers	{ 2 3
Dimethyl phthalate }		
Acetone }	Solvents, thinners, temporary plasticizers	{ 60 10 10
Alcohol }		
Methyl Cellosolve }		

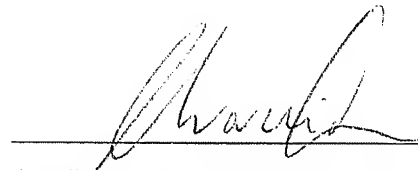
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**Exhibit PNP3**


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one another, the situation changes radically. Obviously one has but to liquefy the two adherend surfaces to make bonding possible. This may be achieved by heat or solvent. No adhesive as such need be introduced. Such are the vagaries of language that the bonding of all plastics to one another, whether adhesive as such is required or not, is called *cementing*. Cementing in this sense is characterized by low pressures ranging from contact up to a maximum of perhaps 30 psi. Room temperature is very common although elevated temperatures are sometimes needed.

The cementing of two layers of identical thermoplast to one another is relatively simple and is conducted by any of three general methods.

1. The surfaces are plasticized with volatile solvent and clamped until bonding has resulted.
2. A solution of the thermoplast is made in an appropriate solvent, which is spread on the surfaces before closure. In both (1) and (2) very careful control of solvent release is usually essential to prevent warping, fogging, or undue disturbance of plasticizer concentration, if plasticizer is present.
3. The surfaces are plasticized by heat alone to a point where they will fuse under light pressure. This is sometimes called *welding*, sometimes *heat sealing*. Decomposition and serious loss of plasticizer must be avoided.

Heat for these operations may be applied by hot air, contact with hot metals, or dielectric devices. Seams can be joined between thin sheets of plastic or plastic-impregnated textile fabrics by passing them through a dielectric heater that looks somewhat like a sewing machine. This "sewing without thread" has initiated important technological advances.

The cementing of dissimilar thermoplasts is often more difficult since it may involve the solubility or thermal behavior of two binders and two or more plasticizers. In a few instances, cementing may be effected by solvent alone, but more usually an adhesive as such is required. An instance of the problems to be met is afforded by cellulose acetate and methyl methacrylate. The former contains considerable plasticizer, the latter none; and if migration of this plasticizer into the methacrylate takes place, crazing results. In this and similar cases the adhesive must not only be without plasticizer but must also "seal in" migratory plasticizers.

The cementing of a thermoset to a second plastic requires adhesive as such, in accordance with the discussion at the beginning of this section.

#### REFERENCES

##### GENERAL

- AMERICAN SOCIETY FOR TESTING MATERIALS, "Symposium on Adhesives," Philadelphia, 1945.

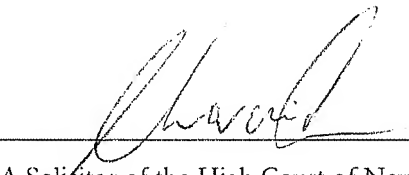
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**Exhibit PNP4**

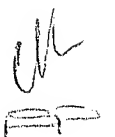
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available at prices competitive to cotton with advantages of luster, drape, wrinkle and soil resistance, low shrinkage, rapid drying, and good weathering resistance.

**Mercerization** The chemical treatment of cotton known as *mercerization* to improve its luster has been practiced for many years. The treatment consists in swelling the cotton by concentrated alkali solution and then washing out the alkali. The chemical changes during the process are similar to those in the formation of alkali cellulose. At the end of the treatment there is no molecular difference in the product, but it is somewhat more amorphous than native cotton and, unless the fibers were held under tension during the process, somewhat less oriented.

As a result of these changes, mercerized cotton is slightly lower in density than the untreated material and has increased water absorption, better dyeability, lower tensile strength, and higher extensibility.


#### *Regenerated cellulose*

The term *regenerated cellulose* describes cellulose which has been dissolved by virtue of the production of a soluble chemical derivative, cellulose xanthate, and subsequently reprecipitated. When prepared as a fiber, regenerated cellulose is known as *viscose* or (viscose) *rayon*. Traditionally both viscose and cellulose acetate have been known as rayons, but the term is now restricted to viscose in order to avoid confusion. As a film, regenerated cellulose is known by the generic term *cellophane*.

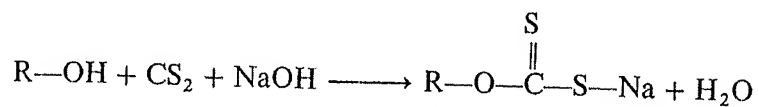
**Manufacture** The first step in the production of regenerated cellulose, starting with purified cellulose usually obtained from wood pulp, is the formation of *alkali* or *soda cellulose*. This is produced by the reaction of cellulose with strong alkalis at low temperatures, and is a further step in the reaction of mercerization.

The exact structure of alkali cellulose is not completely understood. It is certain that some of the alkali (say NaOH) is held in the swollen amorphous regions of the cellulose by hydrogen bonding of the hydroxyl radicals to the cellulose molecules. It is also possible that some alcoholates of the type  $R-ONa$  are formed, where R is the cellulose residue exclusive of one hydroxyl group.

Alkali cellulose is formed by reacting the cellulose pulp with about 18% aqueous NaOH at room temperature for 15 min to 2 hr. The excess alkali is then pressed out and the mass is shredded into "crumbs" and aged for several days at 25–30°C to promote oxidative degradation of the chains to the desired degree of polymerization.



The alkali cellulose is then converted to cellulose xanthate by the addition of carbon disulfide:

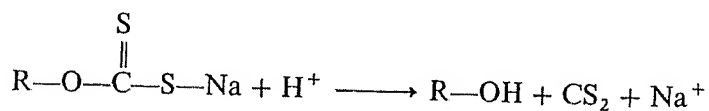


where R is a cellulose residue. The average degree of xanthation is about one  $\text{CS}_2$  for every two cellulose residues. Since the reaction takes place heterogeneously by the addition of liquid or gaseous  $\text{CS}_2$  to the alkali cellulose crumbs, the xanthation in some regions may correspond to the dixanthate or higher.

The mass retains most of its physical form but becomes more sticky or gelatinous and takes on a deep orange color and a characteristic and highly unpleasant odor. It is held at 25–30°C for 1–3 hr with about 10%  $\text{CS}_2$  by weight and then evacuated to remove excess  $\text{CS}_2$ . It is now dissolved in dilute NaOH, becoming completely soluble in this reagent for the first time. The solution is known as viscose. Its color and odor are due to products of side reactions such as  $\text{Na}_2\text{CS}_3$ , NaSH,  $\text{H}_2\text{S}$ , sulfides, and polysulfides.

A fresh viscose solution cannot easily be coagulated and must be allowed to “ripen” for a few days. The changes taking place during ripening are complex, and the reaction must be carefully controlled by time and temperature to avoid premature coagulation.

Cellulose xanthate is essentially unstable and decomposes gradually during the ripening process by hydrolysis and saponification. At the end of the ripening period, enough cellulose residues have been regenerated so that coagulation is imminent. The viscose is then spun into a bath containing sulfuric acid to effect the regeneration of the remaining cellulose residues and coagulate the polymer:



If the spinning process places no mechanical stress on the polymer, it can be obtained in a completely amorphous form. This form is unstable, however, and the application of rather small stresses by such processes as stretching, working, spinning, and extruding causes the cellulose to crystallize (usually to a different structure from that of the native material). In this case, the ordering of the chains is not as great as in the native material, and the density and stiffness of the regenerated product are lower. These differences in density, stiffness, strength, and other properties between native and regenerated cellulose can be accounted for by differences in chain length, chain length distribution, crystal structure, degree of crystallinity, orientation, crystallite size, nature and amount of impurities and other flaws, degree of

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swelling, and chemical reactivity. All these changes on regeneration are in line with the structural differences outlined above.

#### *Viscose rayon*

**Normal tenacity** Viscose rayon normally has a tenacity of 2–2.5 g/denier, somewhat lower than that of cotton (3–5 g/denier). Its wet tenacity is only about half the dry value but is still adequate for laundering. The moisture absorption of viscose is about twice that of cotton. The elasticity is not high (typically 15% elongation at break), and the fiber shows considerable viscoelastic character.

Viscose of normal tenacity is primarily an apparel fiber, but its popularity is declining. Several one-time major manufacturers have ceased producing the material, and the others are operating well below capacity.

**High tenacity** In contrast to apparel rayon, a high-tenacity product (3–6 g/denier) is produced by stretching the fibers just short of their breaking point in the spinning bath. Considerable orientation (and crystallinity) is so introduced. High-tenacity rayon has lower elongation and moisture absorption than the apparel material and is used almost exclusively for tire cord. This market (120 million lb in 1969) is, however, dwindling rapidly with the increasing use of polyester and glass fibers in tires.

#### *Cellophane*

In the manufacture of cellophane the viscose solution is extruded as film and then immersed in a bath of ammonium and sodium sulfate and dilute sulfuric acid, which removes the xanthate groups and precipitates the cellulose. The film is passed through various washing, bleaching, and desulfurizing baths, and finally through a bath of glycerol, glucose, or a polyhydric alcohol, which is imbibed and acts as a plasticizer. The film is then dried. For applications in which low moisture permeability is desired, it is coated with a mixture of nitrocellulose and various plasticizers and waxes.

Cellophane is a thin (0.001–0.002 in.) film of fair physical properties. Its tensile strength is good, but its tear strength, impact strength, and resistance to flexing are poor compared to those of newer film materials. The permeability of the uncoated film to water vapor and to water-soluble gases is extremely high. The coated material passes about 0.3 gram of water vapor/sq in./hr at 40°C. Cellophane is widely used as a wrapping and packaging material.

Cellulose sponges are made by stirring lumps of a salt such as sodium sulfate into viscose, coagulating, and washing out the salt to leave a porous

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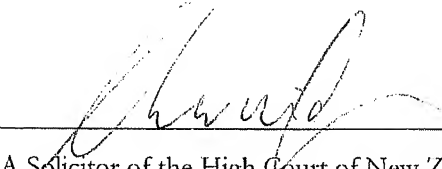


**Exhibit PNP5**

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PETER N PLIMMER Ph.D.

Declared at Auckland this 23<sup>rd</sup> day of March 2007

BEFORE ME:

  
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# PHYSICAL CONSTANTS OF

No.	Name	Synonyms	Formula	Mol. Wt.
2605	Carvacrol.....	2- <i>p</i> -cymenyl; <i>o</i> -methylphenol.....	$\text{C}_9\text{H}_{10}\text{O}$	150.21
2606	—, hexahydro-.....	See <i>Carmenthyl</i> .....	$\text{C}_9\text{H}_{12}\text{O}$	152.23
2607	Carvacrylamine.....	2- <i>p</i> -cymenylamine; 2-amine- <i>p</i> -cymene; 3-isopropyl-2-methylamine; <i>o</i> -methylamine.....	$\text{C}_9\text{H}_{11}\text{N}$	149.23
2608	Carvone.....	See <i>d</i> -limonene.....	$\text{C}_{10}\text{H}_{16}\text{O}$	152.23
2609	Carvone.....	3- <i>p</i> -menthyl-2-one.....	$\text{C}_{10}\text{H}_{16}\text{O}$	152.23
2610	Carveol, dihydro-.....	2-menthyl-8(9)- <i>en</i> -2-ol.....	$\text{C}_{10}\text{H}_{18}\text{O}$	154.25
2611	Carvol.....	See <i>d</i> -Carvone.....	$\text{C}_{10}\text{H}_{16}\text{O}$	152.23
2612	Carvomenthene.....	1- <i>p</i> -menthyl-2-one.....	$\text{C}_{10}\text{H}_{16}$	138.25
2613	Carvomenthol.....	2- <i>p</i> -menthyl-1-methyl-2-oxo-3-methyl-2-ol.....	$\text{C}_{10}\text{H}_{18}\text{O}$	154.25
2614	Carvone, dihydro-.....	2-menthyl-8(9)- <i>en</i> -2-one.....	$\text{C}_{10}\text{H}_{16}\text{O}$	152.23
2615	<i>d</i> -Carvone, oxime.....	<i>d</i> -carvone.....	$\text{C}_{10}\text{H}_{15}\text{NOH}$	165.23
2616	<i>d</i> -Carvone.....	2-6(8(9))- <i>p</i> -menthadien-2-one; carvol.....	$\text{C}_{10}\text{H}_{16}\text{O}$	150.21
2617	<i>d</i> -Carvone, oxime.....	See <i>d</i> -Carvone, oxime.....	$\text{C}_{10}\text{H}_{15}\text{NOH}$	165.23
2618	Carvopyrrolin.....	See <i>d</i> -Carvone, oxime.....	$\text{C}_{10}\text{H}_{15}\text{NO}$	153.21
2619	<i>d</i> -Carvechin.....	See <i>d</i> -Carvechin.....	$\text{C}_{10}\text{H}_{16}\text{O}_2$	180.20
2620	Carvechol.....	See also <i>Carvechol</i> .....	$\text{C}_{10}\text{H}_{16}\text{O}_2$	180.20
2621	<i>d</i> -Carvechol.....	2- <i>p</i> -cymenyl-3,5,7,9-tetra- <i>o</i> -methyl-2-ol (one form); 2,6,8,10-tetra- <i>o</i> -methyl-2-ol (one form).....	$\text{C}_{10}\text{H}_{16}\text{O}_2$	180.20
2622	Cedrene (artificial).....	See <i>Quinacridine</i> , 3,4-dihydro-8-phenyl.....	$\text{C}_{20}\text{H}_{32}$	264.34
2623	Cedrene (artificial).....	See <i>Quinacridine</i> , 3,4-dihydro-8-phenyl.....	$\text{C}_{20}\text{H}_{32}$	264.34
2624	Cedretic.....	See <i>Cerithione</i> .....	$\text{C}_{20}\text{H}_{32}\text{O}_2$	312.30
2625	Cellobiose.....	cellobiose; glucose- $\beta$ -glucoside.....	$\text{C}_{12}\text{H}_{22}\text{O}_{11}$	342.30
2626	—, octaacetate (c).....	octaacetylcellobiose.....	$\text{C}_{48}\text{H}_{80}\text{O}_{28}$	876.89
2627	—, octaacetate (c).....	octaacetylcellobiose.....	$\text{C}_{48}\text{H}_{80}\text{O}_{28}$	876.89
2628	Cellulose.....	See <i>Cellulose</i> .....	$\text{C}_6\text{H}_{10}\text{O}_5$	162.14
2629	—, "Cellulose,".....	See <i>Cellulose</i> .....	$\text{C}_6\text{H}_{10}\text{O}_5$	162.14
2630	—, benzyl.....	See <i>Ethanol</i> , 2-benzyl.....	$\text{C}_8\text{H}_{10}\text{O}$	134.17
2631	—, methyl.....	See <i>Ethanol</i> , 2-methyl.....	$\text{C}_7\text{H}_{10}\text{O}$	114.15
2632	Cellulose.....	See <i>Ethanol</i> , 2-methyl.....	$\text{C}_7\text{H}_{10}\text{O}$	114.15

\*Name approved by the International Union of Chemistry.

# ORGANIC COMPOUNDS (Continued)

No.	Crystalline form, color and index of refraction	Density g/ml	Melting point, °C	Boiling point, °C	Solubility in grams per 100 ml of
2605	oil, 1.53236	0.870	0.5 (1-2)	237.9	Water: s. Alcohol: s. Ether, etc.: s.
2606	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2607	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2608	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2609	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2610	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2611	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2612	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2613	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2614	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2615	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2616	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2617	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2618	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2619	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2620	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2621	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2622	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2623	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2624	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2625	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2626	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2627	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2628	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2629	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2630	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2631	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2632	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.
2633	oil, 1.5431	0.9942	-16	241; 1162	Water: s. Alcohol: s. Ether, etc.: s.

Re explanations and abbreviations see beginning of table.

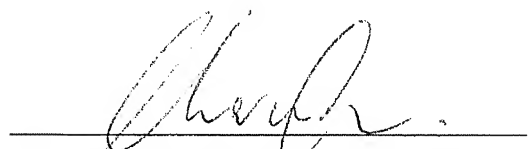


**Exhibit PNP6**

This is the exhibit marked "PNP6" referred to in the annexed Statutory Declaration of  
PETER N PLIMMER Ph.D.

Declared at Auckland this 23<sup>rd</sup> day of March 2007

BEFORE ME:

  
A Solicitor of the High Court of New Zealand

CHARMIAN S.M. OH  
SOLICITOR  
AUCKLAND



of an amorphous material. If it is held at room temperature without further treatment, it gradually hardens while crystallizing with a random crystal arrangement, as shown by a pronounced powder diagram (Fig. 5-7a). Not only are the crystallization phenomena every bit as definite as with a low-molecular-weight compound, but the rate of crystallization at room temperature is considerably greater than that of amorphous sulfur, a significant comparison because the melting points of polyvinylidene chloride and sulfur are similar. In a few cases, high polymers melt sharply. For example, in polyhexamethylene sebacamide (polyamide 6-10), the solid-liquid transition occurs over a 2° interval under equilibrium conditions with little hysteresis. In most cases however, there is considerable hysteresis, which is not surprising in view of the lengths of the molecules and their consequent low mobility and hampered motions.

TABLE 5-8. FIRST-ORDER TRANSITION (TRUE MELTING POINTS) OF HIGH POLYMERS (Melting points of some polyesters given in Table 1-2)

Polymer	Highest First-order Transition Temperature of Unstressed Substance, Deg C
Hevea rubber.....	About 25
Chloroprene.....	About 30
$\beta$ -Gutta-percha.....	56
$\alpha$ -Gutta-percha.....	65
Thiokol A.....	About 70
Polyethylene.....	115
Polyvinylidene chloride.....	185
Cellulose tributyrat.....	185
Polyamide 10-10.....	194
Polyamide 6-10.....	209
Cellulose tripropionate.....	225
Polyamide 10-6.....	230
Polyamide 6-6.....	250
Polyamide 4-6.....	278
Cellulose triacetate.....	302
Polytetrafluoroethylene.....	327

Data from several sources, notably

COFFMAN, D. D., *et al.*, *J. Polymer Sci.*, **2**, 306 (1947).

MALM, C. J., C. R. FORDYCE, and H. A. TANNER, *Ind. Eng. Chem.*, **34**, 430 (1942).

WOOD, L. A., in "Advances in Colloid Science," Vol. 2, MARK and WHITBY, editors, Interscience Publishers, Inc., New York, 1946.

Polyvinylidene chloride and all other high polymers exhibiting such first-order transitions differ in one significant respect from low-molecular-weight substances, *viz.*, during the first-order transition the material may become transparent and softer, but it by no means turns into a mobile liquid. In some cases the substance becomes a very viscous liquid, and in other cases it becomes a rubber. That high polymers do not melt to mobile liquids may be explained as follows (see also Sec. 321).